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INSTRUMENTS THAT STAY ACCURATE

FRANK WD & 1792

OPERATOR'S MANUAL

MODEL 400-2
INSULATION TESTER

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 697-2260
In Canada, Bach-Simpson, Ltd., London, Ontario

Warranty

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

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KATY INDUSTRIES
ELECTRICAL EQUIPMENT GROUP

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MODEL 400-2 INSULATION TESTER

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NOTE: This Operator's Manual contains information essential to the operation of this Instrument. Therefore, it should be kept in a convenient place and used for reference as required.

FIGURE 1-1. INSULATION TESTER

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC Leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

SAFETY SYMBOLS

This marking adjacent to another marking or a terminal or operating device indicates that the operator must refer to an explanation in the Operating Instructions to avoid damage to the equipment and/or to avoid personal injury.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the Instrument.

SECTION I
INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson 400-2 (hereafter referred to as the 400-2 or the Instrument), is a rugged, high-performance, portable, battery-operated insulation tester, capable of making a wide variety of electrical measurements normally used for measuring the resistance of insulation in electrical appliances, switches, machines, and equipment rated up to 500 volts. The 400-2 differs from an ordinary high-range ohmmeter because it actually applies high voltage for testing.

1.1.2 The 400-2 features solid-state circuitry and an accuracy of ±1.5 percent of the full scale length. It allows measurements of AC and DC line voltage on a common linear scale and visual continuity checks.

1.1.3 Ranges and functions are selected by a single, 7-position selector switch. The CONTINUITY range is overload-protected by fuses and current limiting resistance.

WARNING

While the internal resistance of the Instrument is sufficient to limit the short-circuit current between probes to less than five milliamperes, careless usage can cause an electrical shock.

1.2 DESCRIPTION

1.2.1 The 400-2 has permanently attached test leads. The negative lead has a permanently attached test probe containing a pushbutton switch and an indicator/illuminator lamp. The pushbutton energizes the internal battery-powered resistance measuring circuitry and the lamp which, besides providing illumination at

the test point, provides an insulation resistance continuity type indication by extinguishing when the insulation resistance reading falls below 1-2 megohms. The positive test lead is provided with a red handle which accepts either the insulated test probe adapter or the test clip adapter.

1.2.2 For insulation tests, the overall coverage of the 400-2 is divided into three overlapping ranges which are selected by the selector switch. Located to the left of the selector switch is a phenolic slotted screw used to adjust the meter pointer to mechanical zero (no input signal applied).

1.2.3 On each side of the Instrument is a strap attachment used for carrying purposes. Two captivated screws on the rear compartment are provided to facilitate its removal for replacement of the six 1.5 volt batteries or the two fuses.

1.3 SUPPLIES AND ACCESSORIES

1.3.1 All supplies and accessories required for the operation of the 400-2 are furnished with each Instrument, and listed in Table 1-2. Available replacement parts are listed in Table 7-1.

1.4 SAFETY CONSIDERATIONS

1.4.1 This Operator's Manual contains cautions and warnings alerting the user to hazardous operating and service conditions. This information is flagged by CAUTION or WARNING headings throughout this publication, where applicable, and is defined at the front of the manual under SAFETY SYMBOLS. To ensure the safety of operating and servicing personnel and to retain the operating conditions of the Instrument, these instructions must be adhered to.

1.5 TECHNICAL DATA

1.5.1 Table 1-1 lists the technical data for the 400-2.

TABLE 1-1. TECHNICAL DATA

(1)	**Voltage Ranges:**	
	AC, DC	0-600 V
	Internal Resistance:	
	AC	263 K Ω
	DC	292 K Ω
(2)	**Accuracy:**	±1.5% of full scale length for battery voltage from 5-10 VDC on all resistance ranges.
		0 - .4M Ω 98.7mm scale length
		0.1 - 5M Ω 98.7mm scale length
		2 - 200M Ω 107.6mm scale length
		0 - 4 Ω 71.8mm scale length
		V^{AC}_{DC} 89.7mm scale length
(3)	**Movement:**	Moving coil movement with core magnet, shock resistant with spring-loaded jewels.
(4)	**Megohms Ranges:**	
	Range I	0 to 0.4 MΩ
	Open Circuit Voltage	665V
	Internal Resistance	250 kΩ
	Measuring Voltage	0-400V (0-0.4MΩ)
	Range II	0.1 to 5 MΩ
	Open Circuit Voltage	665V
	Internal Resistance	150 kΩ
	Measuring Voltage	260 to 605V (0.1 to 5M)

	Range III	2 to 200 MΩ
	Open Circuit Voltage	665V
	Internal Resistance	150 kΩ
	Measuring Voltage	260 to 605V (2 to 200MΩ)
(5)	**Lamp Operating Point:**	Extinguishes below 1-2MΩ
(6)	**Continuity Range:**	0-4Ω
	Short Circuit Current	223 mA
	Internal Resistance	18.3Ω
	Open Circuit Voltage	4.1V
(7)	**Rated Circuit-To-Ground Voltage:***	Voltage Measurement: 600 V AC DC
(8)	**Power Requirements:**	9V DC supplied by six 1.5 volt batteries, "D" size
(9)	**Lead Characteristics:**	
	Negative Lead	Pushbutton switch, lamp and probe tip
	Positive Lead	Accepts probe or test clip adapter
	Length	Approximately 40" (1M)
(10)	**Instrument Dimensions:**	5.6" high, 4.6" wide, 3.5" deep (141 x 117 x 90mm)
(11)	**Weight:**	3.5 lbs. (1.65kg)

** Per ANSI C-39.5 - 1974: The specified voltage with respect to ground which may be safely and continuously applied to the circuits of an Instrument.*

TABLE 1-2. ITEMS AND ACCESSORIES SUPPLIED WITH THIS INSTRUMENT

Quantity	Description	Part No.
1	Insulation Tester complete with two permanently attached test leads	12509
	Carrying Strap	
6	Battery, 1.5 Volt NEDA Type 13, D Size	1-118722
1	Operator's Manual	6-111860
2	Spare Fuses (inside case)	GO-001081

TABLE 1-3. ADDITIONAL ACCESSORIES

Description	No.
Carrying Case	Cat. No. 01612

SECTION II
INSTALLATION

2.1 GENERAL

2.1.1 This section contains instructions for the installation and shipping of the 400-2. Included are unpacking and inspection procedures, shipping, warranty, power source requirements, and installation.

2.2 UNPACKING AND INSPECTION

2.2.1 Examine the shipping carton for obvious signs of damage. Inspect the Instrument for possible damage incurred during shipment. If damage is noted, notify the carrier and supplier and do not use the Instrument. If Instrument appears to be in good condition, read Operator's Manual in its entirety. Become familiar with the Instrument as instructed in the manual, then proceed to check the electrical performance as soon as possible. Also, check that all items are included with the Instrument (Table 1-2).

2.2.2 Save the shipping carton and packing materials for future storing or shipping of the Instrument.

2.3 SHIPPING

2.3.1 Pack the Instrument carefully and ship it prepaid and insured to the proper destination.

2.4 WARRANTY

2.4.1 The Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting any warranty repair.

NOTE: For assistance of any kind, including help with the Instrument under warranty, contact the nearest Authorized Service Center for instructions (listed on the last pages of this manual). If it is necessary to contact the factory directly, give full details of the difficulty and include the Instrument model number, serial number (at the back of the Instrument) and date of purchase. Service data or shipping instructions will be mailed promptly. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without prior approval.

2.5 POWER SOURCE REQUIREMENTS

2.5.1 The 400-2 is designed to operate from its self-contained six 1.5 volt batteries (furnished with Instrument). Replacement batteries (Table 7-1), can be purchased from any local electronic parts distributor. (For battery installation and battery test, refer to paragraphs 6.2.2 and 6.2.4.)

2.6 INSTALLATION

2.6.1 The Instrument may be operated in either a horizontal or vertical position, however, the horizontal position will yield an improved indicating accuracy.

SECTION III
CONTROLS, CONNECTORS, AND INDICATORS

3.1 GENERAL

3.1.1. All operating and adjustment controls, connectors, and indicators are described in this section along with a list (Table 3-1) describing their function. Become familiar with each item prior to operating the instrument.

TABLE 3-1. CONTROLS, CONNECTORS, AND INDICATORS

1. Range Selector Switch:

Switch Position	Description
Continuity Check (+ or —):	These positions select the low resistance (0-4Ω) range and facilitates reversal of test voltage polarity.
AC OFF/VDC	This position disables the internal supply voltages and selects the voltmeter function. The pushbutton will only energize the probe light for illumination purposes in this position.
0-.4MΩ	Selects the lowest megohm range (0-∞ scale arc). Used also to check electrical zero of megohm ranges.
.1-5MΩ	Selects the .1-5MΩ range (.1-∞ scale arc).
2-200MΩ	Selects the highest megohm range (2-∞ scale arc).

2. Strap Holders: Used to secure the strap for carrying purposes.

3. Mechanical Zero Adjustment: This phenolic screw is used to adjust the meter pointer to mechanical zero.

4. Negative Test Probe: Applies the negative polarity of the internal voltage source to the device or circuit being tested.

a. Translucent lamp housing: Lamp indicates when internal voltage source is energized and test voltage is available at the probe tips. Also, serves as megohm continuity indicator and supplies illumination.

b. Probe tip contacts device or circuit being tested.

c. Pushbutton energizes internal voltage source for resistance measurements. Also, energizes lamp for illumination purposes.

5. Positive Test Probe Handle: Applies positive polarity of internal voltage source to the device or circuit to be tested. Accepts either test adapter a or b.

a. Test probe adapter: Checks voltage measurements; may also be used for resistance and continuity tests.

b. Test clip adapter: Optional for insulation resistance or continuity tests only.

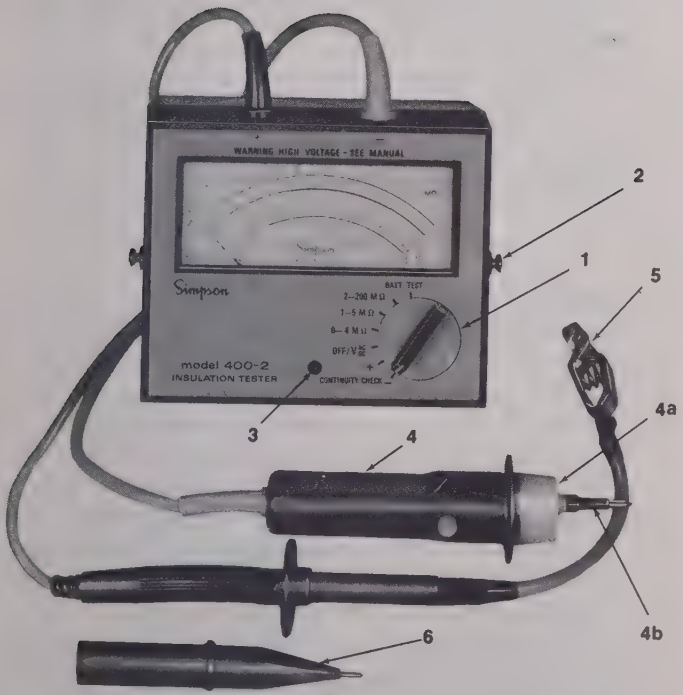


FIGURE 3-1. CONTROLS, CONNECTORS, AND INDICATORS

SECTION IV
OPERATION

4.1 GENERAL

WARNING

Before proceeding with the operation of the 400-2, review the SHOCK HAZARD definition printed at the front of this manual.

4.1.1 This section of the manual contains information required to use and operate the 400-2 in a safe and proper manner.

4.2 SAFETY PRECAUTIONS

WARNING

Voltages may unexpectedly be present in a circuit where resistance is to be measured. The circuit assumed to be de-energized may not be (a residual change may exist) or a charge may have been developed in a highly capacitive circuit by the insulation resistance test. Before making any resistance measurement, make certain the circuit points, between which resistance is to be measured, have no voltage present either between them or between each point and earth ground. After an insulation resistance measurement, check again for the presence of a charged condition.

The OFF/$\overset{AC}{V}$DC function can be used to detect the presence of a hazardous voltage and, if continuously applied, will serve to discharge the circuit.

4.2.1 The 400-2 is designed to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury.

4.2.2 Do not work alone when making measurements where a shock hazard can exist. Notify a nearby person that you are making, or intend to make, such measurements.

4.2.3 Locate all voltage sources and accessibility paths prior to making any measurements or connections.

4.2.4 Inspect the test leads, prods, adapters, and the 400-2 for cracks, breaks, or crazes in the insulation. If any defects exist, destroy and replace the defective item(s) immediately.

4.2.5 Hands and shoes, floor and workbench must be dry. Avoid making measurements under humid, damp, or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or the Instrument.

4.2.6 For maximum safety, do not touch test leads, circuit, or Instrument while power is applied to the circuit being measured.

4.3 OPERATING PROCEDURE

WARNING

Never attempt to make an in-circuit resistance measurement until certain that the circuit is de-energized and/or discharged. Using the OFF/V^{AC}_{DC} range and the insulated probe tip adapter on the positive lead, apply the probe tips to the circuit points between which resistance is to be measured and between each circuit point and earth ground. Any indication above zero on the V^{AC}_{DC} scale is not permissible. De-energize the circuit or, if de-energized, discharge the circuit by continued application of the voltmeter until the indication decreases to zero.

4.3.1 Checking for Presence of Voltage and Voltage Measurement

> **NOTE:** The voltmeter range indicates either AC or DC voltage on the same scale and with the same selector switch position. DC in either polarity will be correctly indicated.

a. Set the selector switch to the OFF/V$^{AC}_{DC}$ position.

b. Attach the probe tip adapter to the positive lead handle.

c. Apply the probe tips to the circuit points to be measured.

> **NOTE:** The pushbutton in the negative handle need not be operated, however, it may be depressed to provide illumination.

d. Observe the voltage indication of the V$^{AC}_{DC}$ scale.

4.3.2 Measuring Insulation Resistance:

a. Make certain that no voltages are present at the circuit points which are to be measured. (Refer to 4.3 and WARNING preceding it.)

b. Set the selector switch to the 0 - .4MΩ position, short the test leads together, and observe that the meter pointer indicates zero on the 0 - .4Ω scale. If not, recheck the mechanical zero adjustment (6.4) and then check the battery condition (6.2.2.) by setting the selector switch to the BATT TEST position. Satisfactory battery condition will indicate within the BATT TEST scale on the meter.

c. With the selector switch set to the 0 - .4MΩ range, apply the test probes to the circuit to be measured and depress the pushbutton.

WARNING

During insulation resistance measurements a voltage as high as 665 volts appears across the test probes. Although the available current is limited to less than 5 milliamperes, it is sufficient to cause a minor electrical shock. If the circuit being measured is capacitive however, it will become charged during the test and create a severe shock hazard. Therefore, avoid any contact with the probe tips and the circuit being measured (as well as with earth ground) during the measurement.

d. In a capacitive circuit the resistance will initially indicate a low value and rise slowly while the voltage is applied. This is a normal condition. The resistance reading should be taken when the pointer has stabilized. Generally, the voltage is applied continuously for one minute before reading the resistance value.

NOTE: A test clip adapter for the positive test lead is provided for convenience in making resistance measurements.

e. If the meter pointer indicates to the left of .4 on the 0 - .4MΩ scale, set the selector to the .1 - 5MΩ and then the 2 - 200MΩ ranges as required to obtain an on-scale indication.

f. IMPORTANT: Immediately upon completion of the resistance measurement, set the selector switch to the OFF/V^{AC}_{DC} and observe the V^{AC}_{DC} scale for the presence of a residual voltage. If any, continue the voltage measurement until the voltage decreases to zero. (The internal resistance of the voltmeter range serves to discharge the circuit.) Only after the voltmeter indicates zero can the leads be disconnected and the circuit be touched safely.

4.3.3 Quick Check (go/no-go) of Insulation Resistance — The lamp in the negative probe lights when the pushbutton is depressed. When connected to measure insulation resistance in accordance with 4.3.2, the lamp will extinguish when the insulation resistance falls below 1 - 2MΩ. (ANSI - C39.5 - 1974, for example, specifies a minimum insulation resistance at 500V of five megohms.) If the lamp extinguishes during the measurement, the item tested has obviously failed the test, thereby avoiding any further need to read the meter indication. Be sure however, to follow the procedures in paragraph 4.3.1 to assure that the circuit is de-energized before, and discharged after the test.

4.3.4 Continuity Check (low resistance measurement):

NOTE: Residual circuit voltage too small to be observed on the V^{AC}_{DC} scale may cause errors in measurements on the 0 - 4Ω range. For this reason there are two selector switch positions marked + and —. Measurements should be made in both polarities and if a difference exists, residual low voltages are present. The correct resistance will be the mean value of the two measurements.

$$R_x = \frac{R_x(+) + R_x(-)}{2}$$

a. If an in-circuit measurement is to be made, check (first) that no measureable voltage is present at the test points to be measured. (Refer to 4.3 and the WARNING preceding it.)

CAUTION

Voltages exceeding .3V DC or .6V AC (not detectable on the V^{AC}_{DC} range) applied to the 0-4Ω range will cause measuring errors and may blow the internal fuses.

b. Set the selector switch to either + or −.

c. Connect the test leads to the circuit.

d. Depress the pushbutton.

e. Read the resistance value on the 0 - 4Ω scale.

f. Reset the selector switch to the other polarity and repeat d and e.

g. If the two values are different, calculate the true resistance as explained in the NOTE above.

NOTE: The open-circuit voltage of the 400-2 on the 0 - 4Ω range is less than 5V and the circuit therefore need not be discharged after a measurement.

4.4 APPLICATION INFORMATION

4.4.1 One of the major purposes for the measurement of insulation resistance is the monitoring of the insulation quality of expensive electrical equipment to detect deterioration of the insulation and initiate corrective action before a catastrophic failure occurs. By making insulation resistance measurements periodically and keeping records of the resistance value, a decline of the insulation resistance will be readily apparent. The following are examples of a few of the many applications of insulation testers:

a. AC Motors: To check insulation resistance on disconnected motors, connect the negative test lead to the motor frame and the positive alligator clip to the motor leads.

b. DC Motors: The overall resistance of all the components of a DC motor can be checked by measuring the resistance between ground and the brush mechanism. To measure the

insulation resistance of the armature or field alone, remove the brushes from the commutator ring. The field is checked by measuring between the frame ground and the brushes. The armature is checked by measuring between rotor laminations and the commutator segments.

c. Transformers: Test the disconnected transformer by connecting the positive alligator clip to either the primary or secondary winding, and the negative test probe to ground. Also, check resistance between primary and secondary winding.

d. Switches: Check insulation resistance from ground to terminals and between terminals.

e. Appliances: Check insulation resistance between the power cord leads and all accessible metal parts of the appliance.

f. Flooded Equipment: After the equipment has been cleaned and dried thoroughly, check its insulation resistance and compare with records of previous measurements taken before the flooding. A substantially lower value indicates that the insulation is not dry enough, is contaminated, or may be permanently damaged.

SECTION V
THEORY OF OPERATION

5.1 GENERAL

5.1.1 Power Supply — The high test voltage of the 400-2 is generated by a transistor-oscillator power supply which receives its operating power from the six batteries in the rear compartment. An automatic control circuit holds the high test voltage source stable.

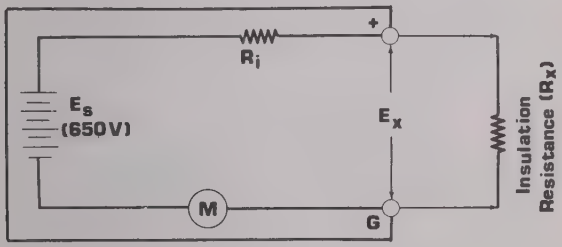


FIGURE 5-1. METERING CIRCUIT

5.1.2 Insulation Resistance Measurement:

a. During zero adjustment, the test leads are shorted together and the meter indicator is adjusted to full scale (Figure 5-1). This will subtract the influence of the meter circuit from the insulation measurement. The current flowing in the metering circuit is now proportional to the insulation resistance R_x. Therefore, the meter deflection will indicate the insulation resistance value directly in terms of MΩ.

b. To determine the test voltage, which depends on the resistance under test, the following formula is used:

$$E_x = E_s \frac{R_x}{R_x + R_s}$$

Where:

E_s = open circuit voltage (665V)

R_s = .25MΩ for 0 - .4MΩ range

R_s = .15MΩ for .1 - 5MΩ and 2 - 200MΩ ranges

R_y = value of resistance under test

The illustration below (Figure 5-2) is provided for checking calculated results.

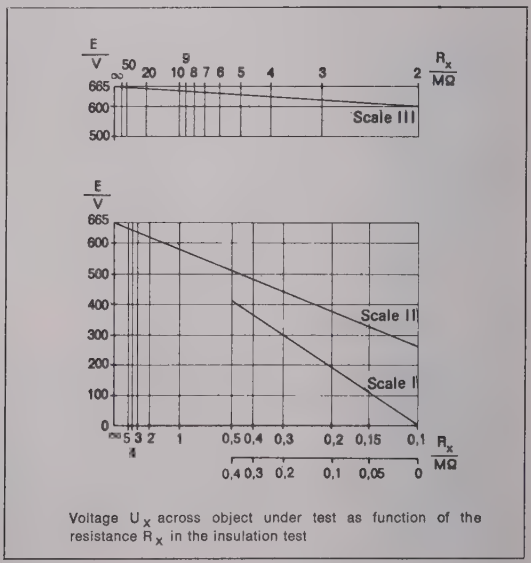


FIGURE 5-2. TEST VOLTAGE GRAPH

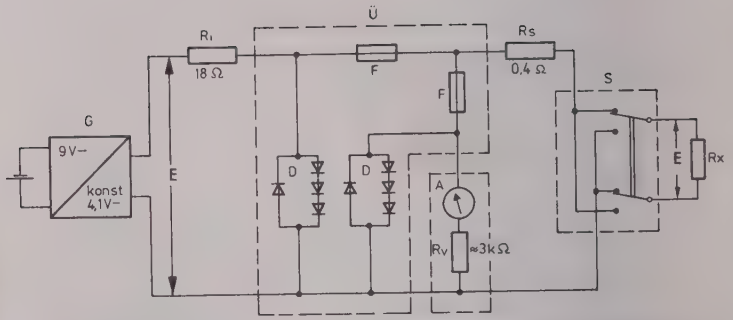
5.1.3 Low Value Resistance (continuity check):

a. The constant open-circuit voltage E_o of the transverter G feeds the circuit which is formed by the internal resistance R_i, the fuse F, the protective resistor R_s and the resistance R_x of the device under test (Figure 5-3). The instrument A indicates the voltage drop of the series connection ($R_s + R_x$). With a protective resistor R_s of constant value, the indication depends only on the resistance R_x of the device under test. With $R_x = 0$, the indication, therefore, deviates from the mechanical zero.

b. The protective resistor R_s serves to limit the current in the case of overload.

c. The overload protection E, consisting of two superquick-action melting fuses F with a rating of 500V and of two groups of power diodes D in antiparallel connection, protects the instrument against damage when an external voltage of up to 500V is accidentally applied. Two melting fuses are required so that the different resistance values of the fuses will not influence the measured result. If only one fuse were used, it would have to be connected in series with the protective resistor R_s, and would directly enter into the measured result (4.3.4).

d. With the switch S, the polarity of the measuring voltage E_x across the device under test R_X can be reversed to eliminate errors in indication due to external voltages.



A = Indicating instrument
D = Power diodes
F = Melting fuse
G = Transverter
R_i = Internal resistance
R_s = Protective resistor

R_v = Series resistor of the indicating instrument
R_x = Resistance of the device under test
S = Polarity reversal switch for the measuring voltage
U_o = Constant open-circuit voltage
U_x = Voltage across the device under test
Ü = Overload protection

FIGURE 5-3. BASIC CIRCUITRY FOR THE MEASUREMENT OF LOW-VALUE RESISTANCES

SECTION VI
OPERATOR SERVICING

6.1 GENERAL

6.1.1 This section will describe maintenance and service procedures that may be performed by the operator.

6.2 ROUTINE MAINTENANCE

6.2.1 Insulation of the 400-2 must be clean and undamaged to perform its function adequately. Prior to each usage of the 400-2, inspect the probes and adapters, test leads and the outer enclosure of the 400-2 for cracks, chips, or deterioration of insulating parts. If any such flaws are found, have them repaired before using the unit. If insulation has become dirty or coated with some contaminant, clean the insulation with a cloth dampened in a 5 percent detergent in water solution, rinse with a clean damp cloth, and dry thoroughly before using. Do not use chemical solvents on plastic insulation.

6.2.2 Battery Check:

a. First check that the mechanical zero is properly adjusted (refer to paragraph 6.4).

b. Set the selector switch to BATT TEST position.

c. Depress the pushbutton on the negative probe.

d. The meter should indicate between the limits of the BATT TEST scale.

e. If the indication is out of the limits, replace the batteries in accordance with paragraph 6.2.4.

6.2.3 Fuse Check (0 - 4Ω range only):

a. Set the selector switch to either the + or – CONTINUITY CHECK position.

b. Short the test probes together.

c. Depress the pushbutton on the negative probe.

d. The meter should indicate at or very near to zero on the 0 - 4Ω scale.

e. If the meter does not indicate, either the batteries are dead or the fuses are blown. Check batteries (6.2.2) and if satisfactory, replace the fuses. If the unit still does not operate, it should be returned to the factory for repair.

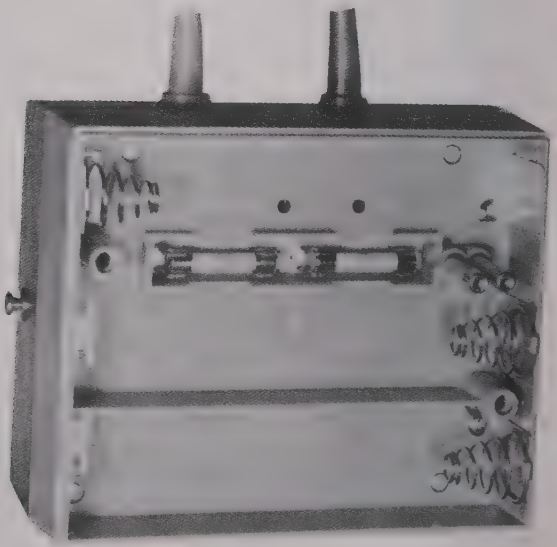


FIGURE 6-1. REAR COMPARTMENT VIEW

6.2.4 Battery or Fuse Replacement:

a. Disconnect the test probes from any circuitry and set the selector switch to the OFF position (to avoid electrical shock).

b. Loosen the two captivated screws on the rear compartment cover.

c. With the 400-2 lying on its front panel, carefully lift off the rear cover. The batteries and fuses will be exposed.

d. Remove the defective batteries or fuses:

- If batteries are being replaced, observe correct polarity as marked on the bottom of the compartment (negatives toward the spring contacts).
- If fuses are being replaced, install the spare fuses stored adjacent to the active fuses. Be sure to replace the spares at the earliest opportunity to forestall the use of unsuitable substitute fuses, should they be needed again.

WARNING

These are 500V fuses and they must not be replaced with 250V fuses. (Refer to Table 7-1 for ordering information.)

e. Replace the rear cover and tighten the two captivated screws making certain that the cover is fully seated in place.

6.3 INDICATOR LAMP REPLACEMENT:

a. Disconnect the test probes from any circuitry and set the selector switch to the OFF position.

b. The plastic cap is held in place by the black plastic probe tip. Unscrew the probe tip and remove the cap.

c. Unscrew the lamp from its socket and replace it with a new lamp.

d. Reinstall the plastic cap, positioning it carefully into its keyed position and replace the probe tip tightening it securely (finger tight).

6.4 ADJUSTING MECHANICAL ZERO:

a. Place the 400-2 in a horizontal position. Observe that the meter pointer comes to rest exactly at the "0" mark of the $\overset{AC}{V_{DC}}$ scale.

b. If not, re-adjust the zero adjustment screw (to the lower left of the selector switch) in a direction that will bring the pointer exactly to zero. Tap the meter lightly with a finger to relieve friction while making the adjustment.

6.5 CHECK FOR ELECTRICAL ZERO:

a. Set selector switch either to + or − position.

b. Short the test probes together.

c. Depress the pushbutton on the negative probe and observe that the meter indicates within ±1.5% of scale length (±1.08mm) of the zero mark on the 0 - 4Ω scale.

d. If the error is excessive, check the mechanical zero (5.7) and the battery condition (5.3). If these do not correct the condition, recalibration is required.

WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SECTION VII
SERVICING INSTRUCTIONS

NOTE: This instrument is a special purpose device requiring special knowledge, training and equipment to service properly. Improper repairs may result in a condition hazardous to the operator. Repairs other than those described in the Operator Servicing section should be referred to a nearby Authorized Service Center (listed on the last pages of this manual) or directly to the factory. (Refer to paragraphs 2.3 and 2.4.)

7.1 GENERAL

7.1.1 The following information is provided as an adjunct to the overall text contained in this manual and should be read and understood thoroughly prior to ordering replacement parts for the Instrument.

7.2 REPLACEMENT PARTS

7.2.1 Table 7-1 lists parts needed for servicing the 400-2. (Refer to Tables 1-2 and 1-3 for items supplied with and accessories available for use with the 400-2.)

7.2.3 Replacement parts may be obtained from a nearby Authorized Service Center (listed on the last pages of this manual) or from the factory. (Refer to paragraph 2.4.1 for ordering instructions.)

TABLE 7-1. REPLACEMENT PARTS

Description		Part Number
Fuse	Special, Quick-Acting, 1.6A, 500V, Type FF, package of ten	GO-001081
Battery	1.5V NEDA Type 13 (D size)	1-118722*
Lamp	2.25V, lens type, No. 222	5-116607
Replacement Test Probe and Clip Adapters (set)		ME-000562

* *Flashlight battery available in most local stores.*

NOTES

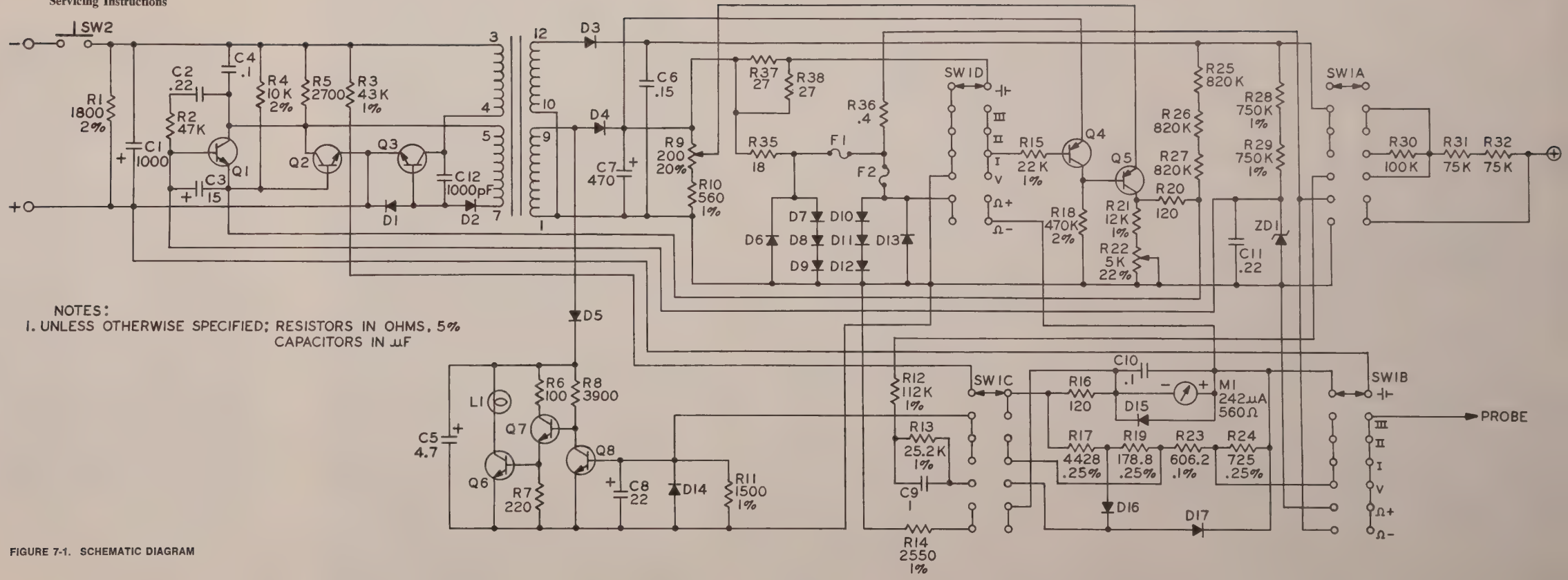


FIGURE 7-1. SCHEMATIC DIAGRAM

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Tel. 907/277-1497

★ALASKA, ANCHORAGE 99500
R. M. ZOOK & ASSOCIATES
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Tel. 907/272-6917

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